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ingly, animals poisoned with strychnia try to move in the ordinary way, but every attempt brings on a tetanic fit, so that it is plain that the spinal cord may also be excited by the brain to its peculiar actions.

6. If the tetanus produced by strychnia has been strong, the *muscles are less irritable* and pass much sooner into the state of *cadaveric rigidity*, which is very strongly marked, and seems to last longer than it generally does. The same early onset of rigidity may be observed in animals killed by tetanus excited by electricity.

X. "Researches on the Foraminifera."—Part II. By WILLIAM B. CARPENTER, M.D., F.R.S., F.G.S. &c. Received June 19, 1856.

(Abstract.)

In the pursuance of his plan of minutely examining certain typical forms of Foraminifera, for the purpose of elucidating their history as living beings, and of determining the value of the characters they present to the systematist, the author in this memoir details the results of his investigations on the genera *Orbiculina*, *Alveolina*, *Cyclolypeus*, and *Heterostegina*.

The genus *Orbiculina* has long been known, through its prevalence in the West Indian seas, which causes its shells to abound in the shore-sands of many of the islands of that region. These shells present great varieties of form, and have been ranked under three distinct species; but M. d'Orbigny has correctly inferred, from a comparison of a large number of specimens, that their diversities of form are partly attributable to differences in the stage of growth, and partly to individual variation, so that all the *Orbiculinæ* of Cuba, the Antilles, &c., are referable to but one specific type. Of the essential features of its structure, however, he would seem to be quite ignorant; since he ranges *Orbiculina* in a distinct order from *Orbitolites*, to which it is very closely allied. This alliance was first pointed out by Prof. Williamson, whose account of the structure of *Orbiculina*, though defective and erroneous in certain points, is nevertheless correct in the main.

The author has had the opportunity of examining not merely a

VOL. VIII. S

considerable number of West Indian specimens, but also a set of specimens peculiarly remarkable for their high development, which form part of Mr. Cuming's Philippine collection. Many of these present the form of flattened disks, marked with concentric circles, and having one or more rows of pores at their edges, not distinguishable, save by their prominent central nuclei, from certain forms of *Orbitolites* formerly described. The similarity is equally great in their internal structure; so that, if a marginal fragment only were submitted to examination, it would not be possible to say with certainty whether it belonged to an *Orbitolites* or an *Orbiculina*. The distinguishing character of the latter is derived from its early mode of growth, which is uniformly *spiral*; and from the circumstance that each of the first three or four turns of the spire not merely surrounds, but invests its predecessor, thereby producing an excess in the thickness of the earlier over that of the later-formed portion, which gives rise to the central protuberance already mentioned. The transition from the spiral to the cyclical mode of increase is effected (just as it is in those individuals of *Orbitolites* which begin life upon the spiral type) by the opening-out of the mouth of the spire, which extends itself on either side around the previously-formed body, until its two divisions meet on the opposite side, where they coalesce so as to constitute a complete annulus. This transition may take place at any period of growth after the completion of the first four or five turns of the spire; so that we sometimes meet with small specimens which have already become discoidal and taken-on the cyclical plan of growth, whilst we occasionally meet with full-grown specimens which retain the spiral form, and show no tendency whatever towards the assumption of the cyclical plan of growth. These facts obviously point to the very subordinate value of *plan of growth* as a distinctive character.

The author next proceeds to a like investigation of the genus *Alveolina*, which he shows to bear a very marked resemblance to *Orbitolites* and *Orbiculina*, in the simple concretionary texture of the shell, in the freedom of communication everywhere existing among the chambers, in the mutual relations of these to each other, and in their mode of communication with the exterior; whilst its plan of growth is very different, the axis round which the spiral turns being greatly elongated, and every additional whorl of the spire pro-

ducing a much greater augmentation of its length than of its diameter. There is obviously a close *physiological* relationship between this genus and the preceding, since the condition of each individual segment of the sarcode-body must be essentially the same in each; and it is merely in the mode in which these segments are multiplied,—a character which we have seen not to be constant in different parts even of the same specimens of *Orbitolites* and *Orbiculina*,—that it differs from them.

A marked contrast to *Orbitolites* and *Orbiculina* in all their physiological characters, coexisting with an agreement in their respective plans of growth, is presented by the genera *Cycloclypeus* and *Heterostegina*; the former of which, like *Orbitolites*, is cyclical from the beginning, its chambers being formed in successive annuli round a central cell; whilst the latter, like *Orbiculina*, is spiral in the first instance, but tends, as age advances, to assume the discoidal shape and cyclical plan of growth. The genus *Cycloclypeus* is a new one, founded by the author upon specimens dredged-up by Sir E. Belcher off the coast of Borneo. These are the largest Foraminifera at present known to exist; the diameter of some of them being not less than  $2\frac{1}{4}$  inches. The genus *Heterostegina* was formed by M. d'Orbigny; but he seems only to have been acquainted with young specimens, and has altogether misapprehended its true characters and relations. A fragment of the flattened spire of *Heterostegina* could scarcely be distinguished from a marginal portion of the disk of *Cycloclypeus*; so close is the conformity between the two, as regards the form and relations of the chambers, their mode of communication, and the structure of their shelly envelope. Each chamber, as in *Nummulites*, has its own proper wall, so that the partition between the adjacent chambers, whether of the same row or of different rows, is double; and between its two lamellæ there is interposed an additional stratum of shell that belongs to neither. This additional stratum is thin, in the septa dividing adjacent chambers of the same row; but it is much thicker, and forms a much more complete separation, in the septa intervening between different rows. It is traversed by a canal-system, analogous to that existing in *Nummulites*; which the author believes to be occupied in the living state by threads of sarcode, and to be specially destined for the nutrition of the 'intermediate skeleton' formed by the aggregate of these inter-

posed lamellæ. The chamber is covered-in above and below by successive layers of a minutely-tubular and peculiarly-compact shell-substance, resembling dentine in its general aspect; certain parts of this, however, are non-tubular, and form cones, of which the bases appear on the surface as minute rounded tubercles. The adjacent chambers of the same row do not seem to communicate with each other; but each chamber communicates with two chambers of the previously-formed row, and, in like manner, with two of the subsequently-formed row, by narrow passages, the number and position of which are by no means constant. These passages seem to afford the principal means whereby the segments of the sarcode-body occupying the inner chambers, can be nourished from the exterior; but it is by no means impossible that the tubuli of the shelly laminæ that invest the chambers above and below, may also be subservient to this purpose, since, however numerous may be the laminæ, the tubuli are continued through them all from the cavity of the chamber to the external surface.

The almost entire separation of the segments of the sarcode-body in these two genera, the investment of each of them with its own proper envelope of shell, the minutely-tubular structure and firm consistence of the shell-substance, and the interposition of the intermediate skeleton with its canal-system, are features that place them in such marked contrast with *Orbitolites* and *Orbiculina*, that, notwithstanding their conformity to those two genera in their respective plans of growth, it is scarcely possible for them to be more widely removed in everything that relates to their respective physiological conditions.

From a comparison of the five genera whose structure has been thus elucidated, the author deduces the conclusion that, in this class, external form, which depends exclusively on plan of growth, affords no clue whatever to internal structure; and that the latter alone, as the exponent of the physiological condition of the animal, can afford the basis of a natural classification.